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(54) **IMAGE FORMING APPARATUS HAVING DECOLORIZING FUNCTION AND SHEET CONVEYING METHOD IN THE IMAGE FORMING APPARATUS**

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G03G 15/16	(2006.01)
G03G 15/01	(2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0136*** (2013.01); ***G03G 15/161*** (2013.01); ***G03G 15/0189*** (2013.01)
USPC **399/341**; 399/335

(58) **Field of Classification Search**
None
See application file for complete search history.

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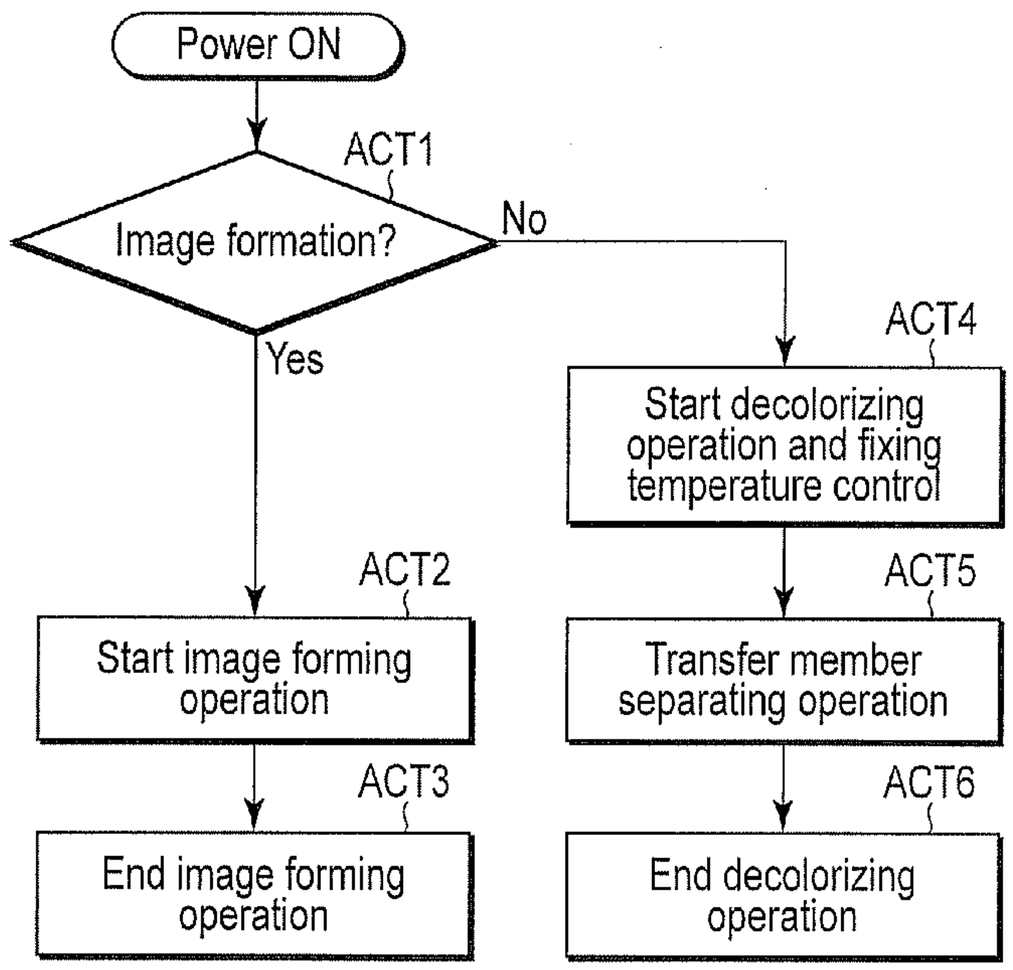
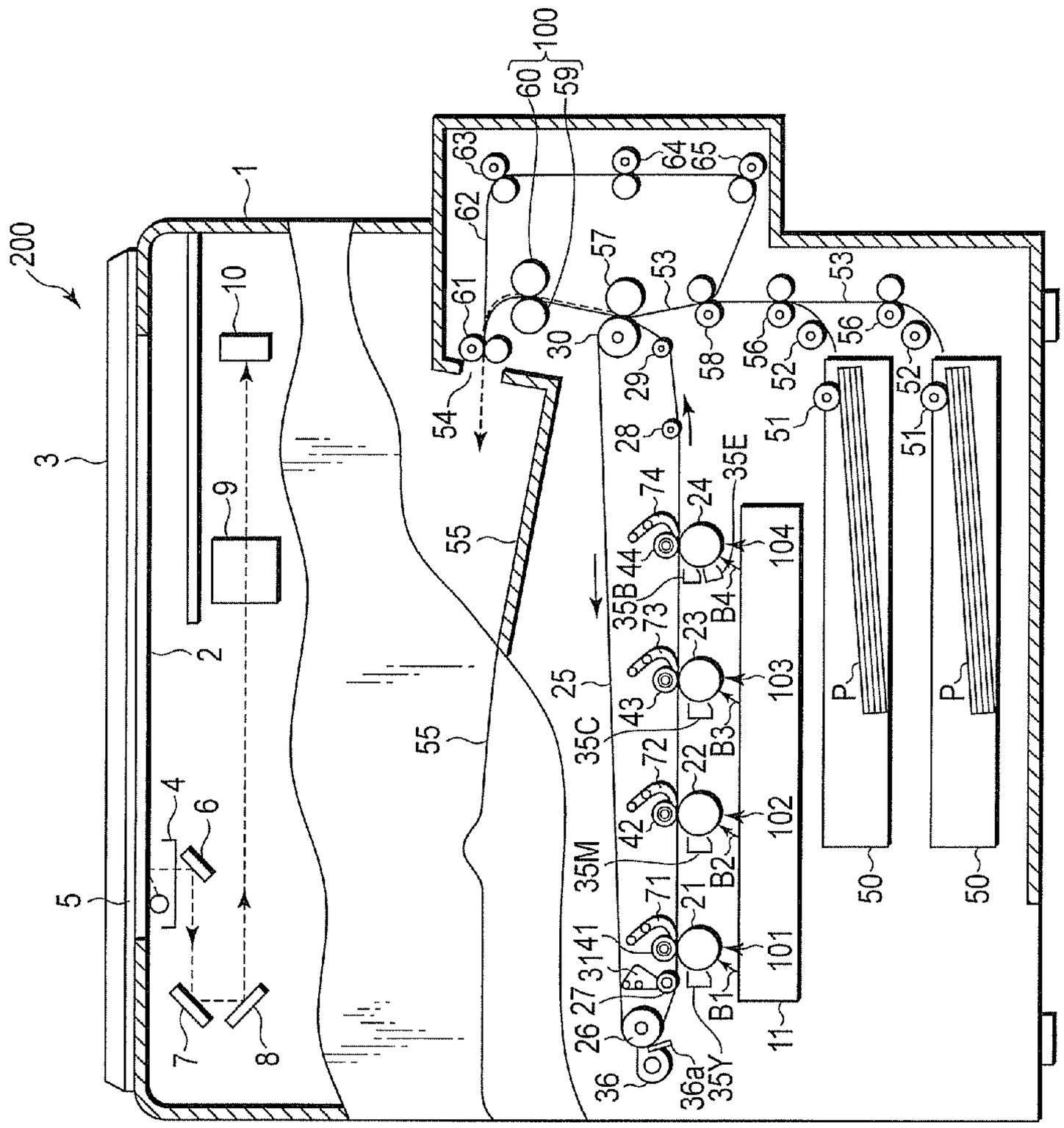
(57) **ABSTRACT**

According to one embodiment, an image forming apparatus includes an image forming unit including an image carrier, a developing device for developing an electrostatic latent image formed on the image carrier using a developing agent containing a decolorable toner and forming a developing agent image, and a transferring and conveying mechanism and a fixing and decolorizing mechanism. In a decolorizing mode, the image carrier and a transfer member are separated in the transferring and conveying mechanism to secure a conveying path to prevent a transfer material from coming into contact with the image carrier. A decolorable image is decolorized at second temperature higher than first temperature in the fixing and decolorizing mechanism.

7 Claims, 7 Drawing Sheets




200
1
2
3
4
5
6
7
8
9
10
11
21
22
23
24
25
26
27
28
29
30
31
35B
35C
35E
35M
35Y
36
36a
41
42
43
44
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
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71
72
73
74
100
101
102
103
104
B1
B2
B3
B4
P

FIG. 1

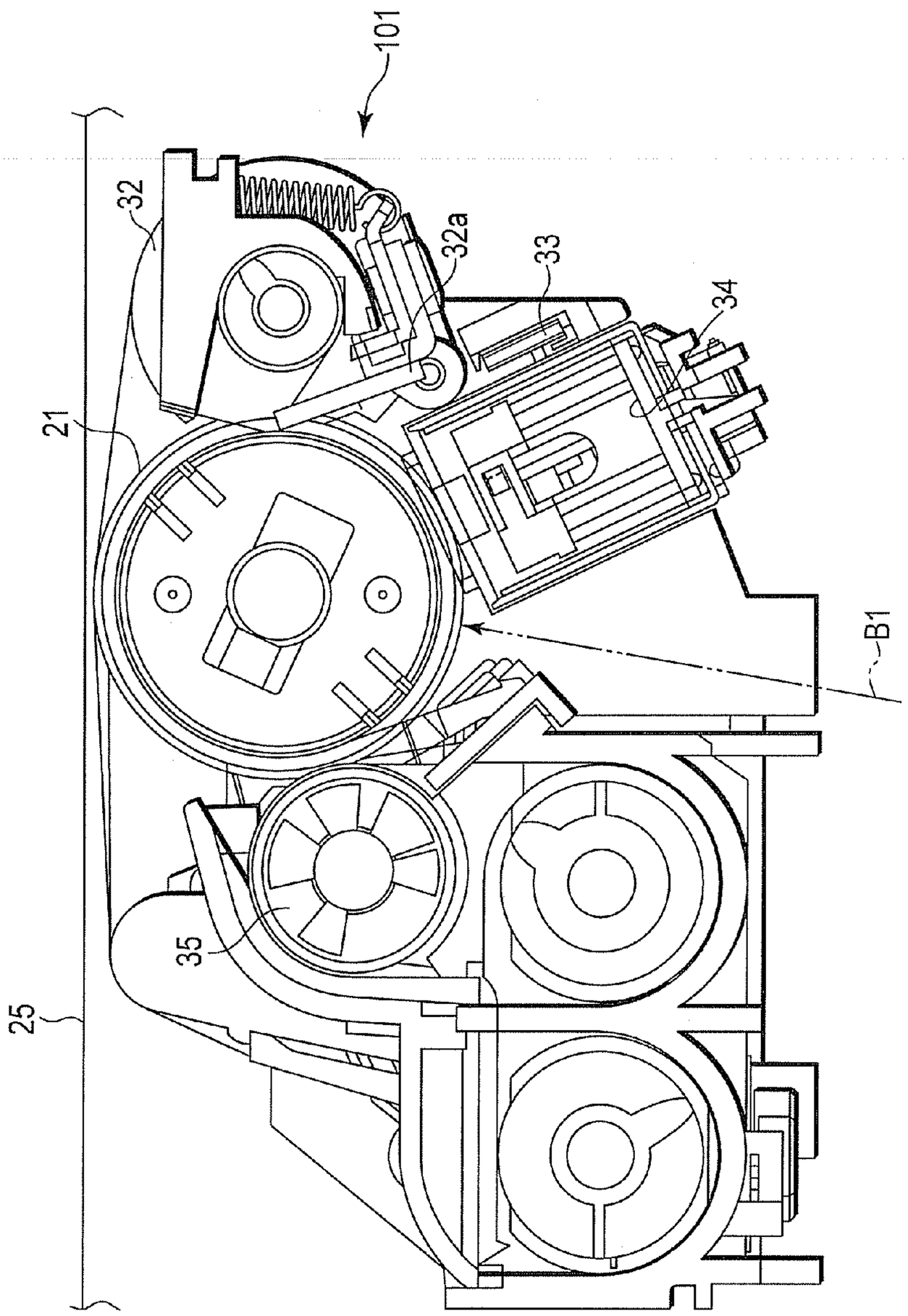

FIG. 2

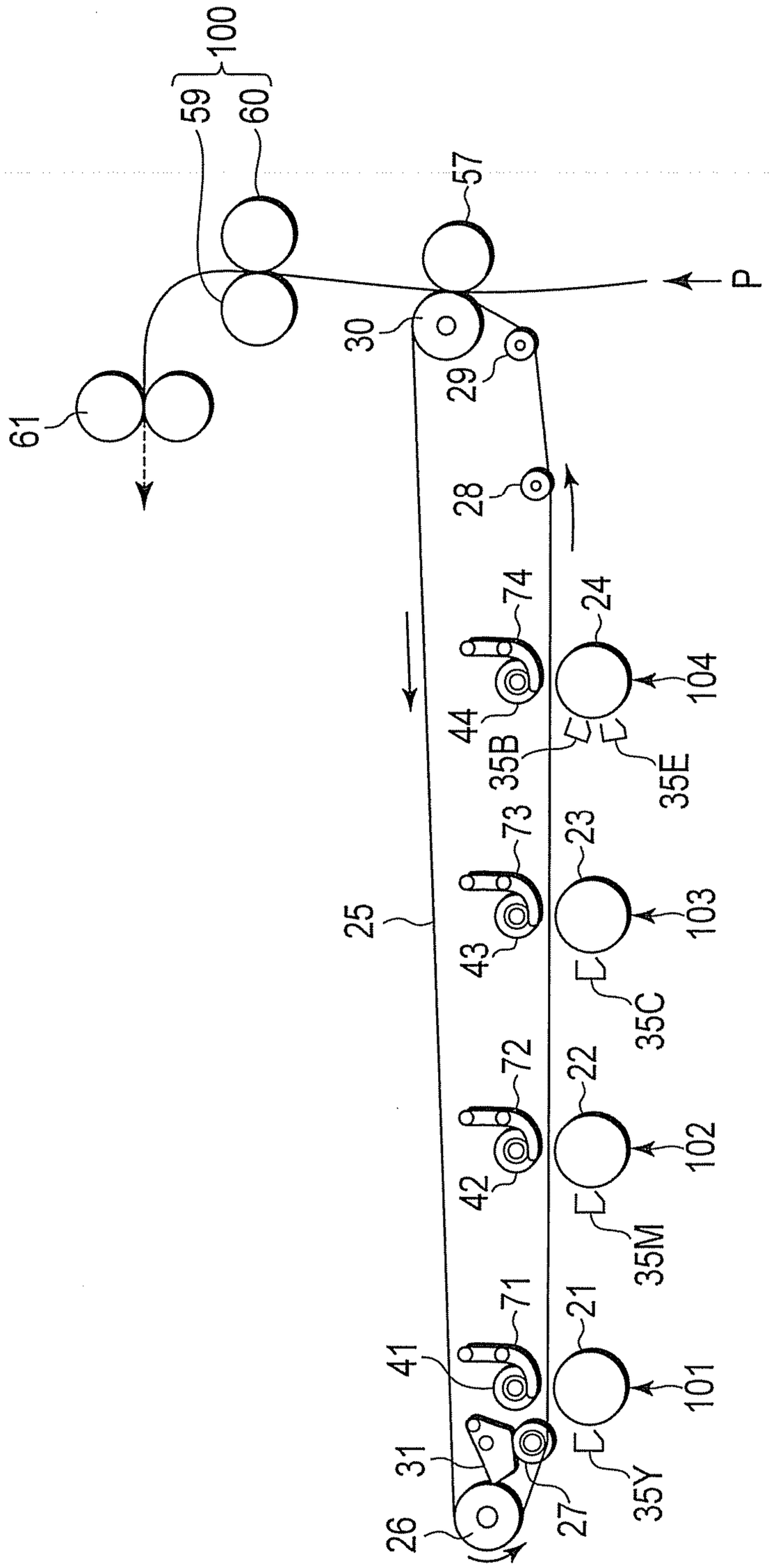
100
59
60
57
P
30
29
61
28
74
24
44
104
35B
35E
73
23
25
43
103
35C
72
22
42
102
35M
71
21
41
101
35Y
31
27
26

FIG. 3

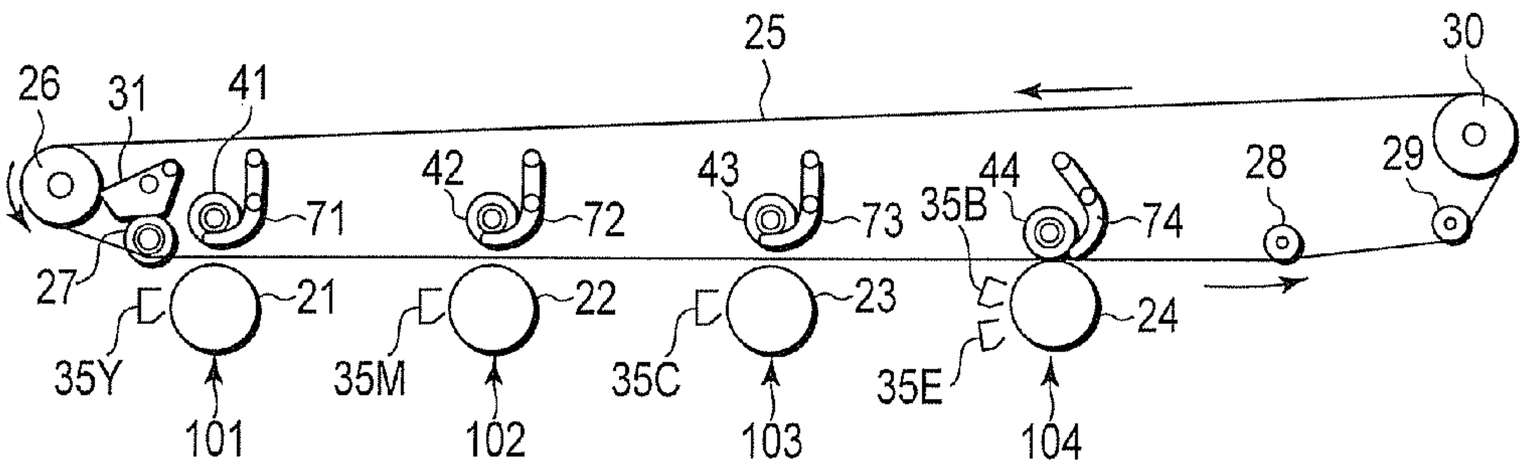
25
30
26
31
41
42
43
44
28
29
71
72
73
74
35B
27
21
22
23
24
35Y
35M
35C
35E
101
102
103
104

FIG. 4

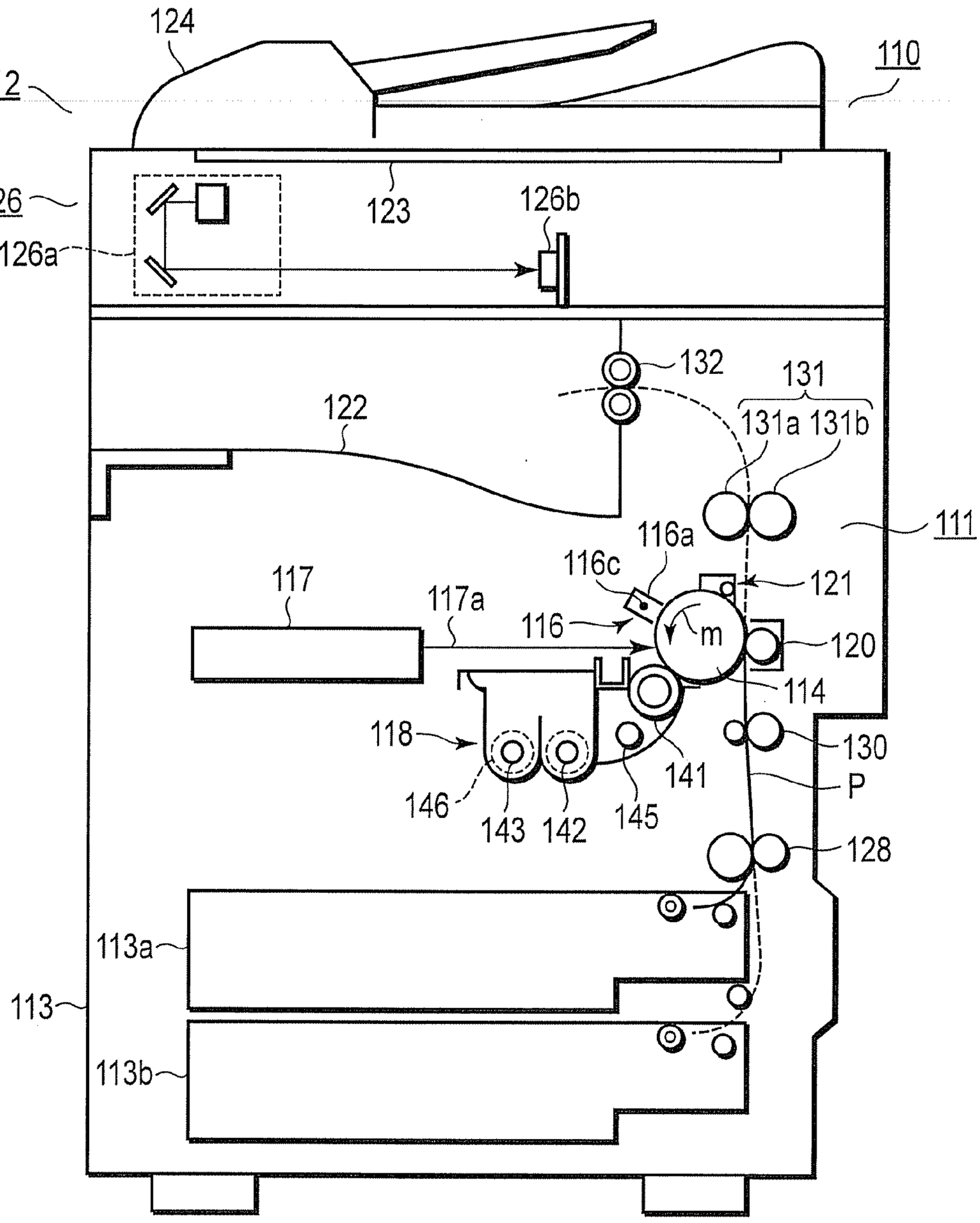
124
112
110
126
123
126b
126a
132
131
122
131a 131b
111
116a
116c
117
121
117a
116
m
120
114
118
130
141
P
146
143 142
145
128
113a
113
113b

FIG. 5

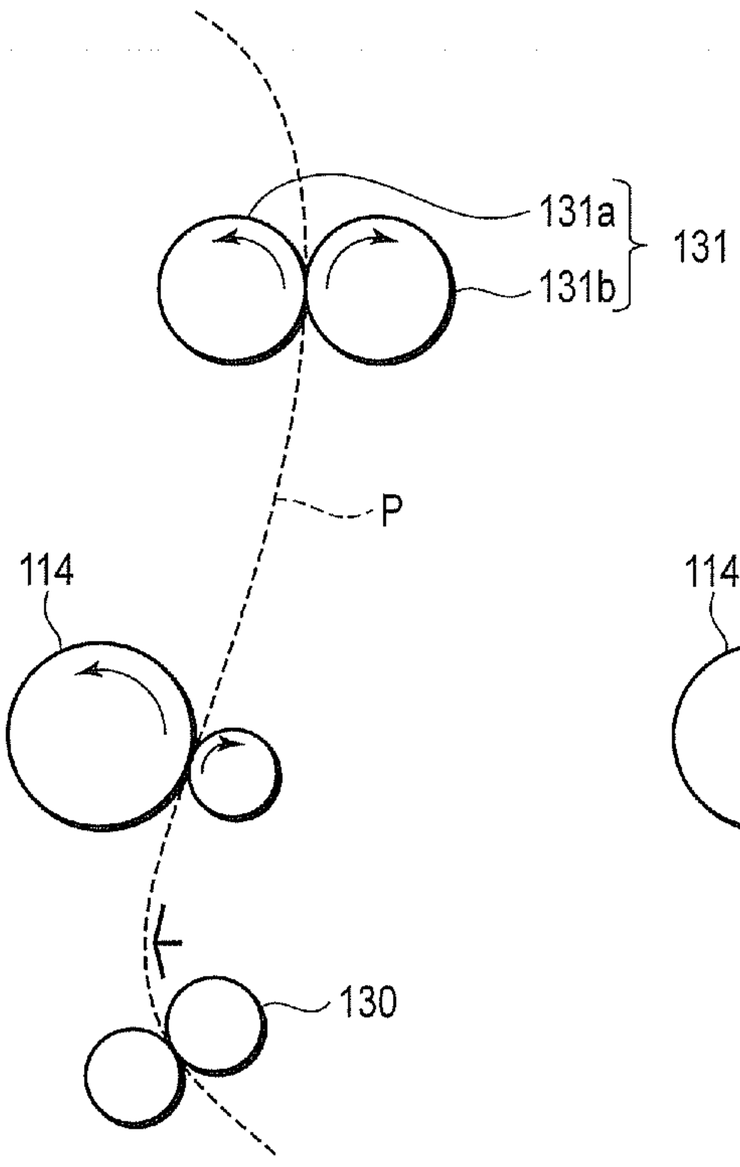

FIG. 6

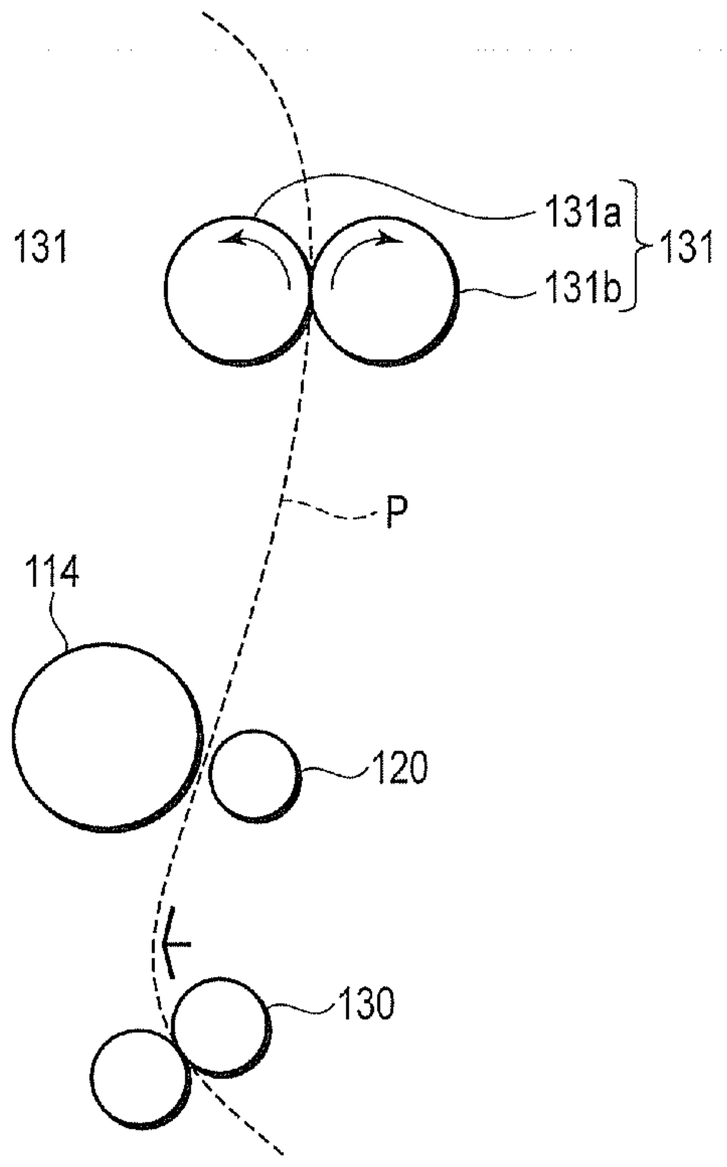

FIG. 7

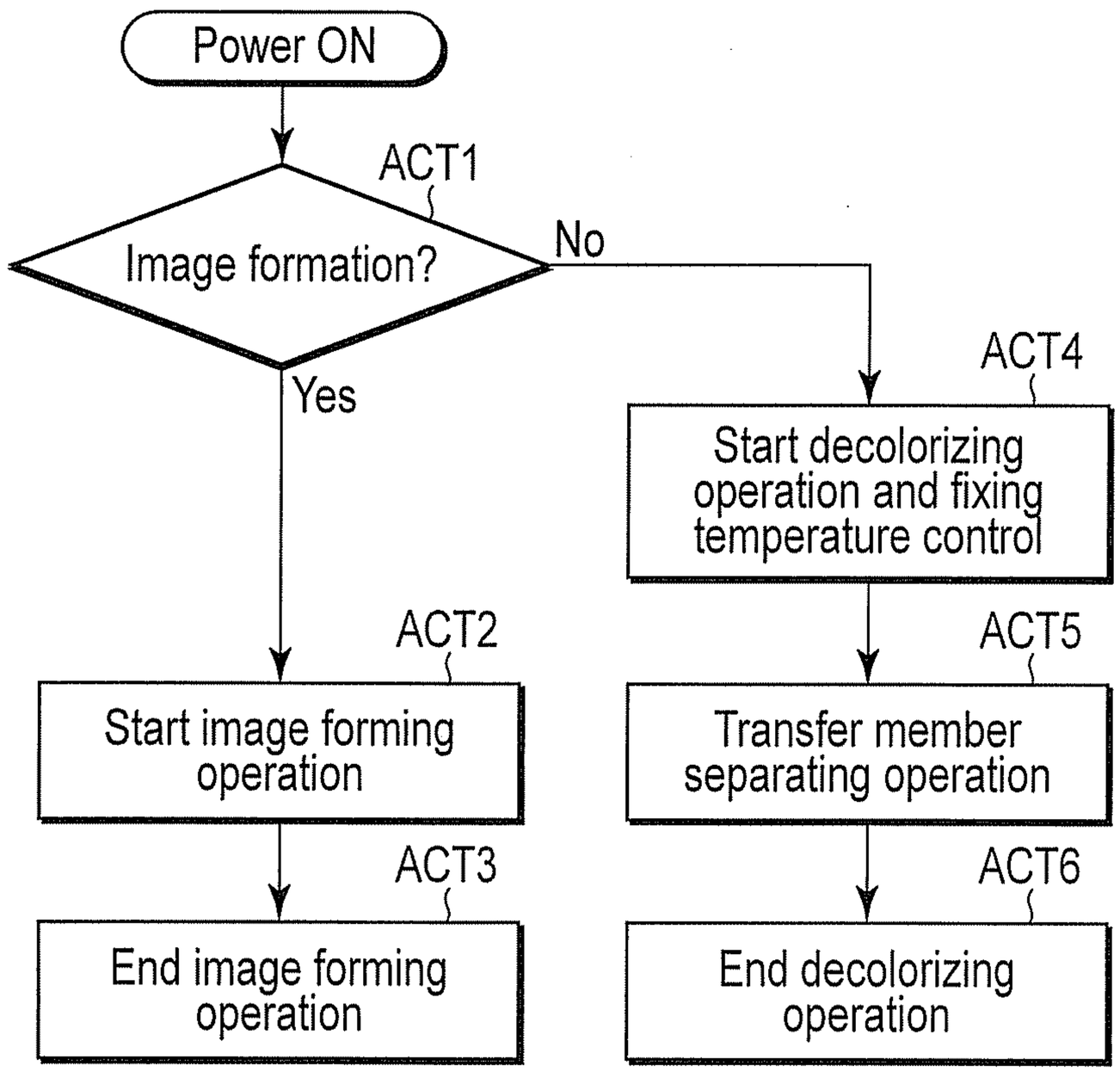
Power ON
ACT1
Image formation?
No
Yes
ACT4
Start decolorizing operation and fixing temperature control
ACT2
Start image forming operation
ACT5
Transfer member separating operation
ACT3
End image forming operation
ACT6
End decolorizing operation

FIG. 8

IMAGE FORMING APPARATUS HAVING DECOLORIZING FUNCTION AND SHEET CONVEYING METHOD IN THE IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from U.S. Provisional Application No. 61/552,615, filed on Oct. 28, 2011, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to an image forming apparatus used in an electrophotographic method, an electrostatic printing method, a magnetic recording method, and the like and a sheet conveying method in the image forming apparatus.

BACKGROUND

In the past, there is an environmentally friendly technique in which a color of a recording material on paper is erased by heating to enable the paper to be repeatedly used. However, for the environmentally friendly technique, an apparatus that erases an image is necessary separately from an image forming apparatus. Therefore, costs for installing the apparatus increase. Further, complicated work will be required. Therefore, an image forming apparatus imparted with a function of a decolorizing apparatus is proposed. However, the life of the image forming apparatus is reduced by driving during decolorizing.

When the image forming apparatus is used as the decolorizing apparatus, a sheet is discharged from a sheet storing section through a transfer section and a fixing section. If the image forming apparatus performs secondary transfer, when the sheet passes the transfer section, a secondary transfer roller and a transfer belt need to be driven. However, when the transfer belt is driven, the life of a drum is reduced because of friction of the transfer belt and the drum.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exemplary view showing an image forming apparatus according to an embodiment;

FIG. **2** is a diagram showing the configuration of a part of an image forming unit shown in FIG. **1**;

FIG. **3** is a diagram for explaining the operations of image forming units and a fixing and decolorizing mechanism shown in FIG. **1**;

FIG. **4** is a diagram for explaining an example of the operation of the image forming units shown in FIG. **1**;

FIG. **5** is a schematic diagram showing an example of a single-color image forming apparatus;

FIG. **6** is a diagram for explaining an example of the operation of an image forming unit shown in FIG. **5**;

FIG. **7** is a diagram for explaining another example of the operation of the image forming unit shown in FIG. **5**; and

FIG. **8** is a flowchart for explaining a work flow during the operation shown in FIG. **5**.

DETAILED DESCRIPTION

In general, according to one embodiment, an image forming apparatus having a decolorizing function, the image forming apparatus including: an image carrier; a developing device for developing an electrostatic latent image formed on the image carrier using a developing agent containing a decolorable toner and forming a developing agent image; a transferring and conveying mechanism including a transfer member and configured to press the transfer member against the image carrier and selectively execute processing for transferring the developing agent image onto a transfer material and processing for separating the image carrier and the transfer member and conveying the transfer material without driving the image carrier; and a fixing and decolorizing mechanism configured to selectively execute processing for fixing the developing agent image transferred onto the transfer material at first temperature and forming an image with a decolorable toner and processing for decolorizing an image formed with the decolorable toner at second temperature higher than the first temperature. As the transfer member, a contact transfer device such as a transfer roller or a transfer device of a secondary transfer type is used. The contact transfer device is directly opposed to and in contact with the image carrier. In the transfer device of the secondary transfer type, an intermediate transfer belt is pressed against the image carrier to transfer a toner image on the intermediate transfer belt onto a transfer material.

According to an embodiment, during decolorizing, the transfer member and the image carrier are separated and an image forming unit is not driven. Therefore, it is possible to prevent the wear of the image carrier and extend the life of the image forming apparatus having the decolorizing function.

A plurality of the image forming units can be provided. The developing agent containing the decolorable toner can be applied to a developing device of at least one image forming unit.

The embodiment is more specifically explained below with reference to examples.

FIG. **1** is schematic diagram showing an example of a color image forming apparatus according to the embodiment.

As shown in FIG. **1**, in an image forming apparatus **200**, a transparent document table (a glass plate) **2** for placing an original document is provided in an upper part of a main body **1**. A cover **3** is openably and closably provided on the document table **2**. A carriage **4** is provided on the lower surface side of the document table **2**. An exposure lamp **5** is provided in the carriage **4**. The carriage **4** can reciprocatingly move along the lower surface of the document table **2**. The exposure lamp **5** is lit while the carriage **4** moves forward, whereby an original document D on the document table **2** is exposed to light. According to the exposure, a reflected light image of the original document D placed on the document table **2** is obtained. The reflected light image is projected on a CCD (Charge Coupled Device) **10** by reflection mirrors **6**, **7**, and **8** and a lens block for magnification **9**. The CCD **10** outputs an image signal corresponding to the reflected light image of the original document D.

The carriage **4**, the exposure lamp **5**, the reflection mirrors **6**, **7**, and **8**, the lens block for magnification **9**, and the CCD **10** configure a scan unit that optically reads an image of the original document D placed on the document table **2**.

The image signal output from the CCD **10** is appropriately processed and then supplied to an exposing unit **11**. The exposing unit **11** emits a laser beam B**1** corresponding to an image signal of a yellow color, a laser beam B**2** corresponding to an image signal of a magenta color, a laser beam **33** corresponding to an image signal of a cyan color, and a laser beam **34** corresponding to an image signal of a black color respectively to a photoreceptor drum **21** for the yellow color, a photoreceptor drum **22** for the magenta color, a photoreceptor

drum **23** for the cyan color, and a photoreceptor drum **24** for the black color or for the decolorable toner.

The photoreceptor drums **21**, **22**, **23**, and **24** are arrayed substantially in a horizontal direction at a fixed interval. A transfer belt **25** is provided above the photoreceptor drums **21**, **22**, **23**, and **24**. The transfer belt **25** is laid over a drive roller **26**, guide rollers **27**, **28**, and **29**, and a driven roller **30**. The transfer belt **25** receives motive power from the drive roller **26** and rotates to travel in the counterclockwise direction. The guide roller **27** is provided to be capable of moving up and down. The guide roller **27** is moved to the transfer belt **25** side by receiving pivoting of a cam (a third cam) **31** to thereby displace the transfer belt **25** to the photoreceptor drums **21**, **22**, **23**, and **24** side.

In a transfer section, primary transfer rollers **41**, **42**, **43**, and **44** are provided to be capable of moving up and down in positions opposed to the photoreceptor drums **21**, **22**, **23**, and **24** across the transfer belt **25**. The primary rollers **41**, **42**, **43**, and **44** are moved (lowered) to the transfer belt **25** side to thereby bring the transfer belt **25** into contact with the photoreceptor drums **21**, **22**, **23**, and **24** and transfer visible images on the photoreceptor drums **21**, **22**, **23**, and **24** onto the transfer belt **25**.

FIG. **1** shows a state in which all the primary transfer rollers **41**, **42**, **43**, and **44** move to the transfer belt **25** side (in the downward direction) and the transfer belt **25** is in contact with all the photoreceptor drums **21**, **22**, **23**, and **24** (hereinafter referred to as image forming mode).

An example of the configuration of an image forming unit shown in FIG. **1** including the photoreceptor drum **21** and a peripheral section of the photoreceptor drum **21** is shown in FIG. **2**.

In an image forming unit **101**, a cleaner **32**, a charge removing lamp **33**, a charging unit **34**, and a developing unit **35**Y are sequentially disposed around the photoreceptor drum **21**. The cleaner **32** includes a cleaning blade **32***a* that is in contact with the surface of the photoreceptor drum **21**. The cleaner **32** scrapes off, with the cleaning blade **32***a*, a developing agent remaining on the surface of the photoreceptor drum **21**. The charge removing lamp **33** removes charges remaining on the surface of the photoreceptor drum **21**. The charging unit **34** applies a high voltage to the photoreceptor drum **21** to thereby charge the surface of the photoreceptor drum **21** with static charges. The laser beam B**1** emitted from the exposing unit **11** is irradiated on the surface of the charged photoreceptor drum **21**. An electrostatic latent image is formed on the surface of the photoreceptor drum **21** by the irradiation. The developing unit **35**Y supplies a developing agent (a toner) of the yellow color to the surface of the photoreceptor drum **21** to thereby visualize the electrostatic latent image on the surface of the photoreceptor drum **21**.

The configuration of an image forming unit **102** including the photoreceptor drum **22** and a peripheral section of the photoreceptor drum **22** and the configuration of an image forming unit **103** including the photoreceptor drum **23** and a peripheral section of the photoreceptor drum **23** are the same as the configuration of the image forming unit **101** except that a developing unit **35**M and a developing unit **35**C are respectively used instead of the developing unit **35**Y. Therefore, explanation of the configurations is omitted.

The configuration of an image forming unit **104** including the photoreceptor drum **24** and a peripheral section of the photoreceptor drum **24** is the same as the configuration of the image forming unit **101** except that a developing unit **35**B for the black color and a developing unit **35**E for the decolorable toner are provided instead of the developing unit **35**Y and the use of the two developing units **35**B and **35**E can be controlled according to image information.

As an example of the decolorable toner, a toner that is fixed at first temperature of 80° C. to 100° C. and decolorized by being heated to second temperature of 130° C. to 150° C. is used.

In this embodiment, as the decolorable toner, a capsule type heat decolorable toner formed by a chemical method explained below is used.

(1) Binder Resin and Wax Atomized Liquid

Polyester resin was used as binder resin. Resin atomized liquid was produced using a high-pressure homogenizer from the polyester resin, an anionic emulsifier, and a neutralizer.

(2) Preparation of Wax Dispersed Liquid

Atomized liquid was obtained by the same method as the method for the resin using rice wax.

(3) Preparation of a Toner

Leuco dye: CVL (crystal violet lactone), a color developing agent: benzyl 4-hydroxybenzonate, and a temperature control agent: lauric acid-4-benzyloxyphenylethyl were heated and melted and encapsulated by a well-known coacervation method. An encapsulated color material, toner binder resin dispersed liquid, and the wax dispersed liquid were condensed and fused using aluminum sulfate ($Al_2(SO_4)_3$) and were cleaned and dried, whereby a toner was obtained. Silica and titanium oxide were externally added to the toner.

A plurality of paper feeding cassettes **50** are provided as a sheet storing section below the exposing unit **11**. A large number of sheets (paper sheets) P of sizes different from one another are stored in the paper feeding cassettes **50**. The sheets P are extracted one by one from any one of the paper feeding cassettes **50**. Pickup rollers **51** are provided in the paper feeding cassettes **50** as rollers for extracting the sheets P. The extracted sheets P are respectively separated from the paper feeding cassettes **50** by separation rollers **52** and supplied to a conveying path **53**.

The conveying path **53** extends to a discharge port **54** in an upper part through the driven roller **30**. The paper discharge port **54** faces a paper discharge tray **55** that extends to the outer circumferential surface of the main body **1**.

On a start end side of the conveying path **53**, paper feeding rollers **56** are respectively provided in the vicinities of the separation rollers **52**. Further, a secondary transfer roller **57** is provided across the transfer belt **25** in a position opposed to the driven roller **30** in substantially a middle part of the conveying path **53**. A registration roller **58** is provided in a position further on the upstream than the driven roller **30** and the secondary transfer roller **57** in the conveying path **53**. The registration roller **58** sends the sheet P into between the transfer belt **25** and the secondary transfer roller **57**. The secondary transfer roller **57** transfers a visible image transferred on the transfer belt **25** onto the sheet P while holding the sheet P sent from the registration roller **58** between the secondary transfer roller **57** and the transfer belt **25** on the driven roller **30**.

In the conveying path **53**, a heat roller **59** for heat fixing and a press contact roller **60** that is in contact with the heat roller **59** are provided in a position further on the downstream side than the secondary transfer roller **57**. A paper discharge roller **61** is provided at the terminal end of the conveying path **53**.

The temperature of the heat roller **59** is set to, for example, first temperature 100° C. lower than second temperature 130° C. of the heat roller **59** in a decolorizing mode. An image transferred onto the sheet P is fixed at the temperature.

A conveying path **62** for reversing the front and the rear of the sheet P is provided from the terminal end of the conveying path **53** to an upstream side position of the registration roller **58**. Paper feeding rollers **63**, **64**, and **65** are provided in the

conveying path **62**. The sheet P that reaches the terminal end of the conveying path **53** is returned to the conveying path **53** through the conveying path **62**, whereby the visible image on the transfer belt **25** is transferred onto the rear side of the sheet P as well.

On the other hand, a cleaner **36** is provided across the transfer belt **25** in a position opposed to the drive roller **26**. The cleaner **36** includes a cleaning blade **36***a* that is in contact with the transfer belt **25**. The cleaner **36** scrapes off, with the cleaning blade **36***a*, the developing agent remaining on the transfer belt **25**.

FIG. **3** is a diagram showing the image forming units and the fixing and decolorizing mechanism in the decolorizing mode.

Hooks **71**, **72**, **73**, and **74** are provided in the vicinities of the primary transfer rollers **41**, **42**, **43**, and **44**. As shown in FIG. **3**, the hooks **71**, **72**, **73**, and **74** engage with shafts of the primary transfer rollers **41**, **42**, **43**, and **44** while pivoting and lift the shafts to thereby move the primary transfer rollers **41**, **42**, **43**, and **44** to separate from the photoreceptor drums **21**, **22**, **23**, and **24** and separate the transfer belt **25** from the photoreceptor drums **21**, **22**, **23**, and **24**.

As shown in the figure, all the hooks **71**, **72**, **73**, and **74** pivot and the primary transfer rollers **41**, **42**, **43**, and **44** move to the opposite side (in the upward direction) of the transfer belt **25**. The transfer belt **25** moves in a state in which the transfer belt **25** is separated from all the photoreceptor drums **21**, **22**, **23**, and **24**. In the conveying path **53**, the sheet P having a decolorable image formed thereon is sent into between the transfer belt **25** and the secondary transfer roller **57** and is led into a fixing and decolorizing mechanism **100** provided in a position on the downstream side of the secondary transfer roller **57**. The heat roller **59** and the press contact roller **60** that is in contact with the heat roller **59** are provided in the fixing and decolorizing mechanism **100**. The temperature of the heat roller **59** is set to, for example, the second temperature 130° C. higher than the first temperature 100° C. of the heat roller **59** in the image forming mode. The image is decolorized in the fixing and decolorizing mechanism **100**.

The image forming apparatus **200** can form an image by selecting any one of a mode for forming an image only with a decolorable toner (hereinafter referred to as decolorable toner single-color mode), a mode for forming an image by combining the decolorable toner and non-decolorable toners (hereinafter referred to as mixed mode), and a mode for forming an image only with the non-decolorable toners (hereinafter referred to as non-decolorable toner single-color mode or non-decolorable toner color mode).

Switching of these modes is performed by, for example, a user inputting an instruction from a not-shown control panel.

In the decolorable toner single-color mode, the developing unit **35**E is used. In other words, an image is formed with a blue decolorable toner.

In the mixed mode, an image is formed by one to three image forming units selected out of the image forming units **101**, **102**, and **103** and the image forming unit **104**. In other words, an image is formed by combining toners of one to three colors selected out of yellow, magenta, and cyan and the blue decolorable toner. For example, when the blue decolorable toner is set to reach the second temperature when being fixed by the fixing and decolorizing mechanism **100**, the blue toner is decolorized and cannot be seen on a sheet.

The decolorable toner is used for recording information concerning image formation such as a date of formation of an image on a sheet and a serial number of an image forming apparatus. If such information is recorded in an invisible form, it is possible to cool the sheet and develop a color of the decolorable toner when such information is necessary later. The recording with the decolorable toner is desirably performed, for example, at an end of the sheet to prevent the decolorable toner from overlapping the non-decolorable toners.

If an image is formed only with the non-decolorable toners, the image is formed by one to four image forming units selected out of the image forming units **101**, **102**, and **103** and the image forming unit **104** including the developing unit **35**B. In other words, an image of a single color selected out of yellow, magenta, cyan, and black or a color image of two to four colors selected out of these colors is formed.

The image forming units **101**, **102**, and **103** do not operate in the decolorable toner single-color mode and in a black toner single-color mode of the non-decolorable toner single-color mode.

FIG. **4** is a diagram for explaining an example of the operation of the image forming units shown in FIG. **1**.

In the decolorable toner single-color mode and the black toner single-color mode, for example, as shown in FIG. **4**, only the hooks **71**, **72**, and **73** pivot, the primary transfer rollers **41**, **42**, and **43** move to the opposite side (in the upward direction) of the transfer belt **25**, and the primary transfer roller **44** stays on the transfer belt **25** side. The transfer belt **25** can be in contact with only the photoreceptor drum **24** for the black color and for the decolorable toner.

The transfer belt **25** receives the pivoting of the cam **31** and moves. The transfer belt **25** can be set in contact with only the photoreceptor drum **24**. Consequently, the image forming units **101**, **102**, and **103** are not unnecessarily driven. The wear of the photoreceptor drums **21**, **22**, and **23**, the intermediate transfer belt **25**, and the like is prevented.

The configuration for engaging the hooks with the shafts of the primary transfer rollers and lifting the shafts is an example of a mechanism for separating the transfer belt and the photoreceptor drums. Other configurations can be used as long as the transfer belt and the photoreceptor drums can be separated.

The image forming apparatus having the decolorizing function includes the sheet storing section, the transfer section, the fixing and decolorizing mechanism, and the mechanism for separating the transfer belt and the photoreceptor drums. The sheet is sent from the sheet storing section to the fixing and decolorizing mechanism through the transfer section. When the sheet passes the transfer section in the image forming mode, the transfer belt and the secondary transfer roller need to be driven. However, the transfer belt is in contact with the primary transfer roller and the photoreceptor drum while being held between the primary transfer roller and the photoreceptor drum. When the transfer belt is driven, the photoreceptor drum is also driven at equal speed. If the image forming apparatus is used as the decolorizing apparatus, since an image is not formed, it is unnecessary to drive an EPU. Since the EPU is not driven, it is possible to prevent friction of the cleaning blades of the photoreceptor drums and the developing agent. However, if only the transfer belt is driven in a state in which the photoreceptor drums are stopped, friction of the photoreceptor drums and the transfer belt is large and the photoreceptor drums and the transfer belt damage each other. Therefore, in the image forming apparatus having the decolorizing function according to the embodiment, if the image forming apparatus is used in the decolorizing mode, the transfer belt and the photoreceptor drums are separated and the EPU is not driven.

If an image is formed by combining the decolorable toner and the non-decolorable toners, it is possible to erase only an image portion formed with the decolorable toner without

changing an image portion formed with the non-decolorable toners. Therefore, applications of the image forming apparatus in which the non-decolorable toners and the decolorable toner are used increase. However, all the developing devices for Y, M, C, and K may include only decolorable toners without including a non-decolorable toner.

FIG. **5** is a schematic diagram showing an example of a single-color image forming apparatus according to an embodiment.

In FIG. **5**, a copying machine **110** includes a printer section **111**, a scanner section **112**, and a paper feeding section **113**.

The printer section **111** includes an image forming unit.

The image forming unit includes a photoreceptor drum **114** that is an image carrier and rotates in an arrow m direction, an electrifying charger **116** that is provided around the photoreceptor drum **114** and uniformly charges the photoreceptor drum **114**, and a laser exposing device **117** that irradiates a laser beam **117***a* on the charged photoreceptor drum **114** on the basis of image data or the like from the scanner section **112** and forms an electrostatic latent image on the photoreceptor drum **114**. The electrifying charger **116** includes a grid on a surface of a case **116***b*, which supports a charge wire **116***a*, opposed to the photoreceptor drum **114**. The electrifying charger **116** and the laser exposing device **117** configure latent image forming means. Further, the image forming unit includes, around the photoreceptor drum **114**, a developing device **118** functioning as developing means for developing and visualizing the electrostatic latent image on the photoreceptor drum **114**.

The developing device **118** includes, in a case **140**, a developing roller **141**, a developing agent supplying mixer **145**, a first mixer **142**, and a second mixer **143**. The developing device **118** performs development using a decolorable developing agent **146**. Further, the image forming unit includes a transfer roller **120** functioning as transfer means for coming into contact with sheet P, which is a recording medium, and transferring a toner image formed on the photoreceptor drum **114** onto the sheet P and a blade cleaner **121** functioning as cleaning means. For example, the scanner section **112** arranged above the printer section **111** via a paper discharge section **122** includes a scanner device **126** that reads an original document placed on a document glass **123** or an original document conveyed by an auto document feeder (ADF) **124**. The scanner device **126** includes an optical mechanism **126***a* that optically reads a document image and a photoelectric conversion element (CCD: charge coupled device) **126***b* that converts an optical signal from the optical mechanism **126***a* into an electric signal.

The paper feeding section **113** below the printer section **111** includes first and second paper feeding cassettes **113***a* and **113***b*. A conveying roller **128** and a registration roller **130** are provided between the paper feeding section **113** and the photoreceptor drum **114**. The registration roller **130** conveys the sheet P to between the photoreceptor drum **114** and the transfer roller **120** in synchronization with the toner image on the photoreceptor drum **114**. A fixing roller **131** and a paper discharge roller **132** are provided between the photoreceptor drum **114** and the paper discharge section **122**. The fixing roller **131** nips and conveys the sheet P having the toner image transferred thereon by the transfer roller **120** and heats and pressurizes the toner image to fix the toner image on the sheet P. The paper discharge roller **132** discharges the sheet P to the paper discharge section **122** after the fixing.

In an image forming process, a toner image is formed on the photoreceptor drum **114** according to image data input from the scanner device **126**, a personal computer terminal, or the like. The toner image on the photoreceptor drum **114** is transferred onto the sheet P by the transfer roller **120**. Thereafter, the sheet P passes a fixing device **131** including a heat roller **131***a* and a pressurizing roller **131***b* to have the toner image fixed thereon. The sheet P is discharged to the paper discharge section **122**. After the transfer ends, the photoreceptor drum **114** passes the blade cleaner **121** and a residual toner on the photoreceptor drum **114** is removed. Then, the image forming process ends.

FIG. **6** is a diagram for explaining an example of an image forming operation of the image forming unit shown in FIG. **5**.

The pressurizing roller **131***b* of the fixing device **131** is pressed against the heating roller **131***a* by a spring force to form a nip. Usually, during the image forming operation, as shown in FIG. **6**, the photoreceptor drum **114** and the fixing device **131** are respectively independently driven to convey the sheet P and perform image formation, transfer of a developing agent image, and fixing. The registration roller **130** is configured to be driven via a gear or a belt according to the driving of the fixing device **131**. The registration roller **130** can be turned on and off by, for example, a clutch. The heating temperature of the heating roller **131***a* is controlled to temperature near 80° C. and the sheet P having the developing agent image transferred thereon is heated in the fixing device **113**, whereby the developing agent image is fixed.

FIG. **7** is a diagram for explaining another example of the decolorizing operation of the image forming unit shown in FIG. **5**. As shown in FIG. **7**, the image forming unit includes a contact and separation mechanism for separating the transfer roller from the photoreceptor drum by 0.5 mm or more during the decolorizing operation in the case of contact transfer. It is possible to prevent the sheet P from coming into contact with the photoreceptor drum **114** to secure a sheet conveying path by separating the transfer roller, convey the sheet P having the decolorable image formed thereon to the fixing device **113** in a state in which the driving of the photoreceptor drum **114** is stopped, and heat the sheet P in the fixing device **113** to thereby decolorize the image. Heating temperature in decolorizing the image is controlled to be decolorable temperature, for example, temperature equal to or higher than 100° C.

If fixing driving speed, i.e., sheet conveyance speed during the decolorizing operation is set to speed lower than fixing driving speed during the image forming operation, it is possible to more surely decolorize the image.

A work flow during operation is shown in FIG. **8**.

As shown in the figure, a power supply is turned on. First, it is determined whether the image forming operation is performed (Act **1**). If the image forming operation is selected, the image forming operation is started (Act **2**). When image formation is completed, the image forming operation is ended (Act **3**). If the decolorizing operation is selected, the decolorizing operation and temperature control for the fixing roller are started (Act **4**). An operation for separating the transfer member and the photoreceptor drum is performed (Act **5**). When decolorization is completed, the decolorizing operation is ended (Act **6**).

The respective operations can be executed according to selection of the image forming mode and the decolorizing mode. Fixing speed during the decolorizing operation can be changed to at least at speed equal to or lower than speed during a print operation according to a toner characteristic. This is for preventing decolorization unevenness that could occur because of the toner characteristic. According to the embodiment, since the decolorizing function is imparted to a fixing apparatus, it is possible to eliminate excessive driving

of the photoreceptor drum during the decolorizing operation. Therefore, it is possible to prevent the short life of the photoreceptor drum.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. An image forming apparatus having a decolorizing function, the image forming apparatus comprising:

an image carrier;

a developing device for developing an electrostatic latent image formed on the image carrier using a developing agent containing a decolorable toner and forming a developing agent image;

a transferring and conveying mechanism including a transfer member and configured to press the transfer member against the image carrier and selectively execute processing for transferring the developing agent image onto a transfer material and processing for separating the image carrier and the transfer member and conveying the transfer material without driving the image carrier, wherein the transfer member is a transfer roller; and

a fixing and decolorizing mechanism configured to selectively execute processing for fixing the developing agent image transferred onto the transfer material at first temperature and forming an image and processing for decolorizing an image formed with the decolorable toner at second temperature higher than the first temperature.

2. The apparatus according to claim **1**, wherein conveying speed of the transfer material during decolorization is lower than conveying speed of the transfer material during image formation.

3. An image forming apparatus having a decolorizing function, the image forming apparatus comprising:

an image carrier;

a developing device for developing an electrostatic latent image formed on the image carrier using a developing agent containing a decolorable toner and forming a developing agent image;

a transferring and conveying mechanism including a transfer member and configured to press the transfer member against the image carrier and selectively execute processing for transferring the developing agent image onto a transfer material and processing for separating the image carrier and the transfer member and conveying the transfer material without driving the image carrier; and

a fixing and decolorizing mechanism configured to selectively execute processing for fixing the developing agent image transferred onto the transfer material at first temperature and forming an image and processing for decolorizing an image formed with the decolorable toner at second temperature higher than the first temperature, wherein

the transfer member includes a transfer belt onto which the developing agent image is primarily transferred, a primary transfer member configured to press the transfer belt against the image carrier, and a second transfer member configured to transfer the developing agent image on the transfer belt onto the transfer material, and

the transferring and conveying mechanism selectively executes the processing for transferring the developing agent image onto the transfer material and processing for separating the transfer belt and the primary transfer member from the image carrier and conveying the transfer material without driving the image carrier.

4. The apparatus according to claim **3**, wherein a plurality of image forming units are provided, wherein image forming units comprise the image carrier and the developing device, respectively.

5. The apparatus according to claim **3**, wherein conveying speed of the transfer material during decolorization is lower than conveying speed of the transfer material during image formation.

6. An image forming apparatus having a decolorizing function, the image forming apparatus comprising:

an image carrier;

a developing device for developing an electrostatic latent image formed on the image carrier using a developing agent containing a decolorable toner and forming a developing agent image;

a transferring and conveying mechanism including a transfer member and configured to press the transfer member against the image carrier and selectively execute processing for transferring the developing agent image onto a transfer material and processing for separating the image carrier and the transfer member and conveying the transfer material without driving the image carrier; and

a fixing and decolorizing mechanism configured to selectively execute processing for fixing the developing agent image transferred onto the transfer material at first temperature and forming an image and processing for decolorizing an image formed with the decolorable toner at second temperature higher than the first temperature, wherein conveying speed of the transfer material during decolorization is lower than conveying speed of the transfer material during image formation.

7. The apparatus according to claim **6**, wherein a plurality of image forming units are provided, wherein image forming units comprise the image carrier and the developing device, respectively.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,874,020 B2
APPLICATION NO. : 13/660166
DATED : October 28, 2014
INVENTOR(S) : Katsutoshi Mita and Yoshinori Sanmonji

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page, item (72), line 2,

Katsutoshi Mita, Izu (JP); Yoshinori Sammonji, Yokohama (JP)

should read:

Katsutoshi Mita, Izu (JP); Yoshinori Sanmonji, Yokohama (JP)

Signed and Sealed this
Twenty-fourth Day of March, 2015

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office